I, Kumiko Kawai of Tranomon East Building, 7-13, Nishi-Shimbashi 1-chome, Minato-ku, Tokyo 105-8408, Japan, hereby declare that I am conversant with the Japanese and the English languages and that I am the translator of the document attached and certify that to the best of may knowledge and belief the following is a true and correct English translation of the specification contained in the Japanese Patent Application No. 2002-308006.

Signed this 25th of April, 2007

Kumiko Kawai

Patent Department

Patent Office
Japanese Government

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application : October 23, 2002

Application Number : Pat. 2002-308006

Applicant(s) : Keyence Corporation

October 31, 2003

Commissioner,
Japanese Patent Office Yasuo Imai
Issuance Number Pat. 2003-3090608

[Document Name]	Patent Application
[Reference Number]	K2002015
[Date of Filing]	October 23, 2002
[Address]	Commissioner, Patent Office Esq.
[Inventor]	
[Address or Residence]	c/o Keyence Corporation, 3-14, Higashinakajima 1-chome, Higashiyodogawa-ku, Osaka-shi, Osaka
[Name]	Kazuhito Saeki
[Applicant for Patent]	
[Identification No.]	000129253
[Name or Appellation]	Keyence Corporation
[Agent]	
[Identification No.]	100098187
[Address or Residence]	c/o Hirai Kozu International Intellectual Property Firm, 41-2-111, Senjuakebonocho, adachiku, Tokyo
[Name or Appellation]	Seiji Hirai
[Telephone Number]	03(5813)0220
[Agent]	
[Identification No.]	100085707
[Address or Residence]	c/o Hirai Kozu International Intellectual Property Firm, 41-2-111, Senjuakebonocho, adachiku, Tokyo
[Name or Appellation]	Takako Kozu
[Identification of Fee]	
[Deposit Account Number]	114994
[Amount of Fee]	21000
[List of Filed Documents]	
[Filed Document Name]	Specification 1
[Filed Document Name]	Drawing 1
[Filed Document Name]	Abstract 1
[Request for Proof]	Yes

[Designation of Document] Specification

[Title of the Invention] Image Processing Apparatus

[Claims]

1. An image processing apparatus capable of setting an edge window in order to calculate edge related information obtained by a user by detecting an edge of work, comprising:

element setting means for setting plural window elements in the one edge window,

edge detection means for scanning each of the window elements and obtaining edges every each the window element, and

calculation means for obtaining the edge related information from the edges detected by said edge detection means.

2. An image processing apparatus as defined in claim 1, wherein a user can arbitrarily set a width of the window element.

3. An image processing apparatus as defined in claim 1 or 2, wherein a user can arbitrarily set a distance between the adjacent window elements.

4. A record medium for recording a program capable of being installed on an image processing apparatus capable of setting an edge window in order to calculate edge related information obtained by a user by detecting an edge of work, the image processing apparatus-readable record medium for recording a program executing:

an element setting procedure for setting plural window elements in the one edge window,

an edge detection procedure for scanning each of the window

elements and obtaining edges every each the window element, and

calculation means for obtaining the edge related information from the edges detected by said edge detection means.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Belongs]

This invention relates to an image processing apparatus.

[0002]

[Prior Art]

As one use aspect of an image processing apparatus, it is configured so that edge related information such as an edge position or the maximum edge width about an edge obtained by a user can be calculated by setting an edge window and detecting an edge of work for detection of variations in work outline. For example, when the maximum edge width W of work w such as cable shown in Fig. 1 is measured, as shown in Fig. 2, plural edge windows 1 are set and the maximum edge width W4 is decided based on output results of edge widths W1 to W4 between edges 2 and 2 of each the edge window 1. The number of such edge windows 1 varies depending on the image processing apparatus and can be set at, for example, up to 8 to 64.

[0003]

Fig. 3 is a flowchart showing a conventional operating procedure including setting of an edge window, and referring to the conventional operating procedure according to this flowchart, in step S1, a user

decides fineness of unevenness of a surface of work w or a width of an edge window in response to size of the work w and an edge window 1 according to the window width decided by the user is set (step S2). When it is necessary to set plural edge windows 1, operations of step S2 are repeated. Next, when the work w is set in an image pickup position and a trigger from the outside is inputted to an image processing apparatus, an image pickup of the work w is performed (step S3).

[0004]

The image processing apparatus captures image pickup data (step S4), and then measures an edge every the edge window 1 set (step S5), and outputs a measured result every each the edge window 1 to an external device (step S6).

[0005]

The external device receives the measured result every each the edge window 1 (step S7), and performs statistical processing of these and obtains, for example, the maximum edge width, an edge position, the number of edges, etc. (step S8), and thereby performs determination processing (step S9).

[0006]

[Objects that the Invention is to Solve]

However, in setting of the edge window 1, the setting operation becomes more complicated for a user as the number of edge windows 1 to be set increases. Also, the external device is required for performing statistical processing.

[0007]

Also, in the case of detecting the tip P of work w having the sharp end as shown in Fig. 4, another problem tends to arise. For example, as shown in Fig. 5, in the case that an edge window 1 in which the entirety of work w having the end of an acute angle is included is set, it becomes difficult to detect the end of the acute angle when the number of pixels read increases in character of a general algorithm of image processing, so that an edge position 2 detected tends to become a position distant from the end of the work w.

[0008]

Therefore, a user has to set a narrow edge window 1 as shown in Fig. 6A, but when such a narrow edge window 1 is set, it cannot cope flexibly with variations from an image pickup position of the work w and as shown in Fig. 6B, a new problem that there is a high possibility that the end P of an acute angle deviates from the edge window 1 arises.

[0009]

Thus, an object of the invention is to provide an image processing apparatus capable of improving accuracy of edge detection without troubling a user where possible.

[0010]

A further object of the invention is to provide an image processing apparatus capable of coping flexibly with variations in an image pickup position of work or difference in properties of the

work.

[0011]

A further object of the invention is to provide an image processing apparatus without the need to prepare an external device and perform statistical processing about edge detection.

[0012]

[Means for Solving the Objects]

According to the invention, such a technical object can be achieved by providing an image processing apparatus characterized by being premised on an image processing apparatus capable of setting an edge window in order to calculate edge related information obtained by a user by detecting an edge of work, comprising:

element setting means for setting plural window elements in the one edge window,

edge detection means for scanning each of the window elements and obtaining edges every each the window element, and

calculation means for obtaining the edge related information from the edges detected by said edge detection means.

[0013]

That is, according to the invention, a setting operation with effort of an edge window finishes one time and after capturing image pickup data, the edge window is scanned every window element fragmented, so that even for work having the sharp tip, an edge of an acute angle can be detected accurately without changing a general algorithm of image processing used conventionally.

[0014]

Also, the inside of the edge window is fragmented into plural window elements and is scanned every each the window element, so that with respect to edge detection, it can cope flexibly with variations in an image pickup position of work or difference in properties of the work.

[0015]

Also, it is easy to internally perform calculation processing of measured results about edges every each the window element, so that there is an advantage that an external device for statistical processing about edge detection is not required.

[0016]

[Mode for Carrying out the Invention]

An image processing apparatus according to the invention can be applied to measurement of edge related information such as the number of edges, an edge position, an edge width, a gap or a center pitch obtained by a user in connection with edge detection. Referring to one embodiment taking measurement of an edge width as an example, plural window elements 10 (four window elements 10 in an example illustrated) are set in one edge window 1 and edge detection is performed every each the window element 10.

[0017]

It is preferably constructed so that a user can freely set a width L of the window element 10 and a distance D between the adjacent window elements 10 and 10.

[0018]

For example, with respect to setting of the width L of the window element 10, it may be constructed so that this width can be set by the number of pixels, or it may be constructed so that a user selects from the number of pixels preset, for example, three stages of coarse (width L is large), fine (width L is small) and moderate (width L is in a state between coarse and fine) and thereby the width L of the window element 10 can be set.

[0019]

In the distance D between the adjacent window elements 10 and 10, for example, it may be constructed so that a distance from start coordinates of one window element 10 to start coordinates of the next window element 10 can be set.

[0020]

By comparing the sizes of edge widths W detected every each the window element 10 inside the image processing apparatus, the maximum value and the minimum value are obtained or the average value is calculated and as necessary, the result is outputted to an external device.

[0021]

Fig. 8 is a flowchart showing an operating procedure of a preferred embodiment, and referring to an operating procedure about detection of an edge width as illustration according to this flowchart, a user decides fineness of unevenness of a surface of work w or a width of an edge window 1 in response to size of the work w in step

S10.

[0022]

In the next step S11, the user sets a width L and a distance D of window elements 10 and in step S12, plural window elements 10 are automatically assigned inside the edge window according to the width L and the distance D set by the user. Then, the work w is set in an image pickup position and a trigger from the outside is inputted to an image processing apparatus and an image pickup of the work w is performed (step S13).

[0023]

The image processing apparatus captures image pickup data (step S14), and then measures edge widths W every each the window element 10 inside the edge window 1 set (step S15), and obtains the maximum edge width W of the edge widths W acquired in each the window element 10 (step S16), and makes a determination about this maximum edge width W and, for example, when the maximum edge width is out of specifications, a determination of NG is made (step S17) and also when necessary, the measured result and/or determined result are outputted to an external device (step S18).

[0024]

According to the embodiment of the invention, as shown in Fig. 9, an edge of an acute angle of work w having the sharp tip can also be detected accurately. Also, by setting a distance D between adjacent window elements 10 and 10 smaller than a width L of a window element 10 (D<L), as shown in Fig. 10, the window elements 10

overlapping mutually can be set to perform edge detection of work w without interruption.

[0025]

With respect to display of the edges detected, for example, when the maximum edge width is measured, it may be constructed so as to display only the result as shown in Fig. 11 and also, it may be constructed so as to perform display every each window element 10 as shown in Fig. 12 and also, it may be constructed so as to perform display in a state in which ranges between edge displays every each window element 10 are complemented by curved lines as shown in Fig. 13.

[0026]

With respect to automatically assigning plural window elements 10 inside an edge window 1, for example, it may be constructed so that a user only specifies the number of window elements 10 and thereby a width L and a distance D of the elements 10 in response to this number of elements 10 are calculated and the window elements 10 are assigned inside the edge window 1 based on its result. Also, it may be constructed so that a user specifies a width L of the window element 10 and thereby a distance D in response to this width L is calculated and the window elements 10 are assigned inside the edge window 1 based on its result. When a distance D between the window elements 10 is substantially calculated inside such an image processing apparatus, it is preferable to internally calculate the distance D so that the window elements 10 are always present in one end and

the other end (left end and right end in the drawing) of the edge window 1.

[0027]

Also, as described in the embodiment, an image processing apparatus into which a program for executing the invention is previously incorporated may be provided for a user, or it may be constructed so that, for example, CD-ROM for recording a program capable of being installed on an image processing apparatus, namely capable of being read by the image processing apparatus is provided for a user who has already acquired the image processing apparatus.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a diagram showing elongated work (for example, cable) illustrated for describing a conventional problem.

[Fig. 2] Fig. 2 is a diagram describing an edge width measurement method by a conventional technique.

[Fig. 3] Fig. 3 is a flowchart describing a conventional operating procedure.

[Fig. 4] Fig. 4 is a diagram illustrating work having the tip of an acute angle in which accurate edge detection is difficult in the conventional technique.

[Fig. 5] Fig. 5 is a diagram describing a detection result of the case of setting a relatively wide edge window to perform edge detection using the conventional technique with respect to the work having the tip of the acute angle.

[Fig. 6] Fig. 6 is a diagram describing a problem of the case of setting a relatively narrow edge window using the conventional technique in order to improve accuracy of edge detection of the work having the tip of the acute angle.

[Fig. 7] Fig. 7 is a diagram conceptually describing an embodiment of the invention.

[Fig. 8] Fig. 8 is a flowchart describing one example of an operating procedure of the embodiment of the invention.

[Fig. 9] Fig. 9 is a diagram describing the fact that the invention can preferably be applied to work having the tip of an acute angle.

[Fig. 10] Fig. 10 is a diagram describing the fact that window elements overlapping mutually can be set in the embodiment of the invention.

[Fig. 11] Fig. 11 is a diagram describing one example of display of edges detected in the embodiment of the invention.

[Fig. 12] Fig. 12 is a diagram describing another example of display of edges detected in the embodiment of the invention.

[Fig. 13] Fig. 13 is a diagram describing the other example of display of edges detected in the embodiment of the invention.

[Description of the Reference Numerals and Signs]

1 EDGE WINDOW

10 WINDOW ELEMENT

w WORK

P END OF ACUTE ANGLE OF WORK HAVING SHARP TIP

W WIDTH OF WINDOW ELEMENT

L DISTANCE BETWEEN ADJACENT WINDOW ELEMENTS

[Designation of Document] Abstract

[Abstract]

[Object]

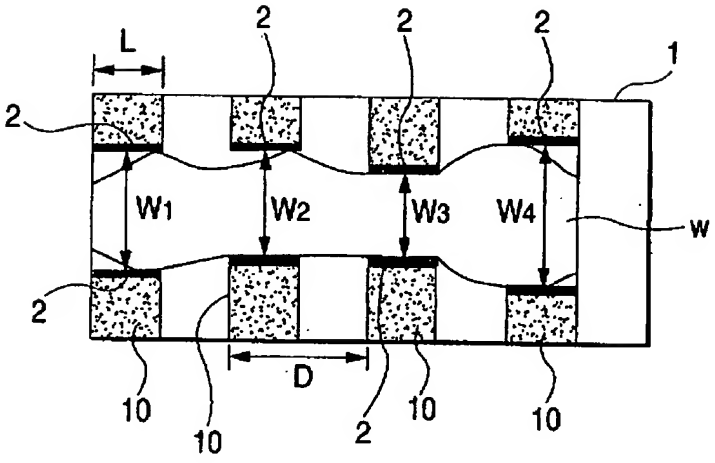
An object is to provide an image processing apparatus capable of improving accuracy of edge detection without troubling a user where possible.

[Means for Resolution]

Plural window elements 10 (four window elements 10 in an example illustrated) are set in one edge window 1, and edge detection is performed every each the window element 10, and calculation and determination about its result are made inside an image processing apparatus. A user can freely set a width L of the window element 10 and a distance D between the adjacent window elements 10 and 10.

[Selected Drawing] Fig. 7

FIG. 7



RECEIVED
CENTRAL FAX CENTER
MAY 09 2007

FIG. 8

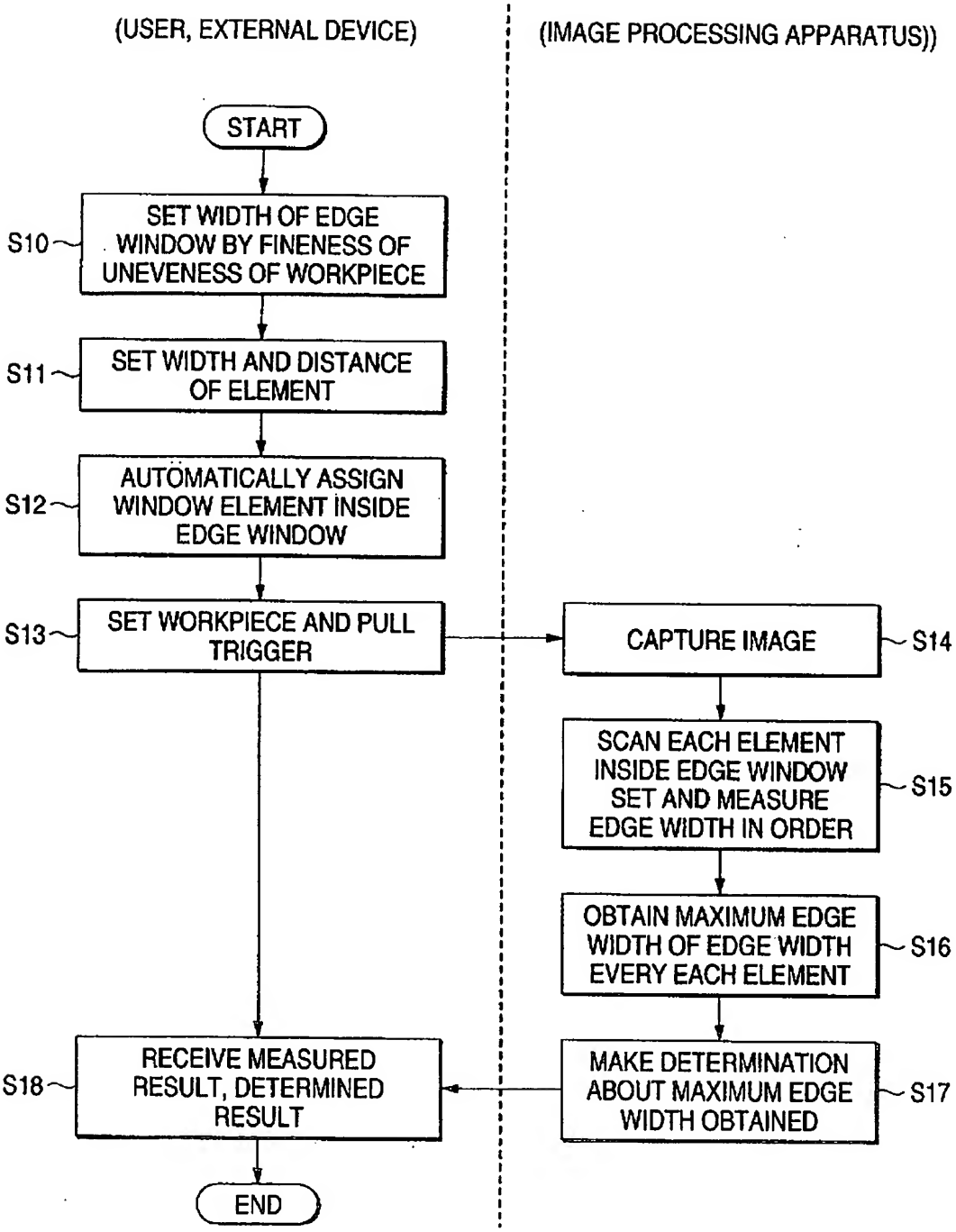


FIG. 9

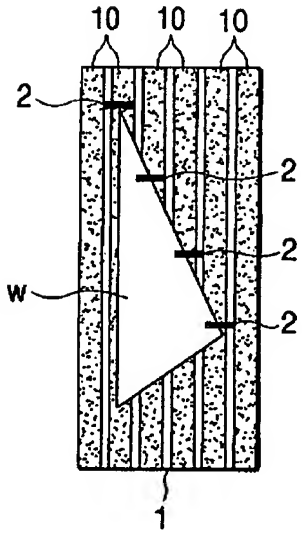


FIG. 10

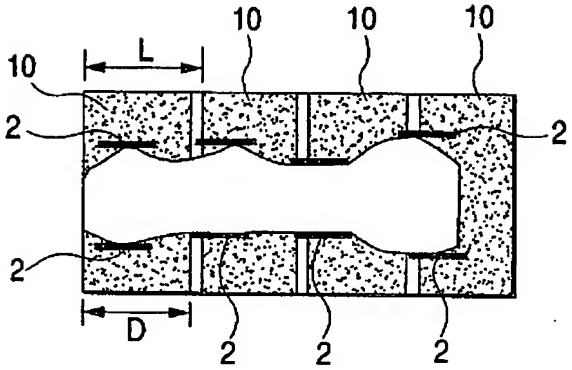


FIG. 11

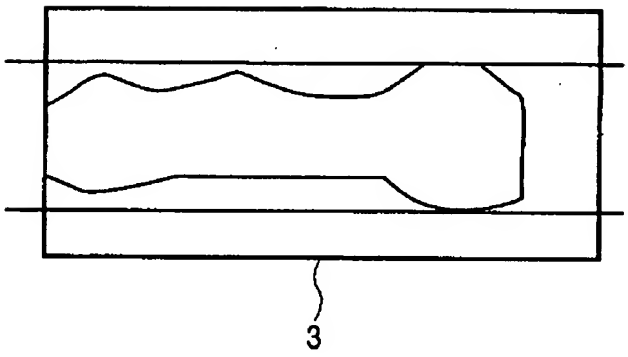


FIG. 12

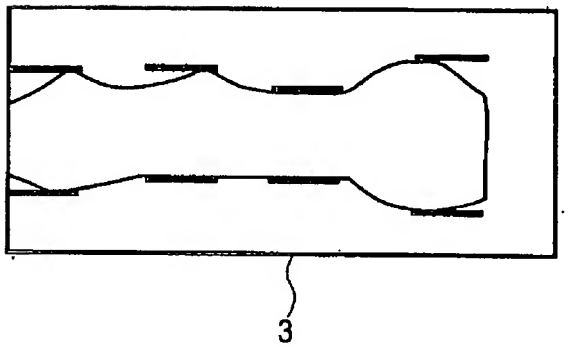


FIG. 13

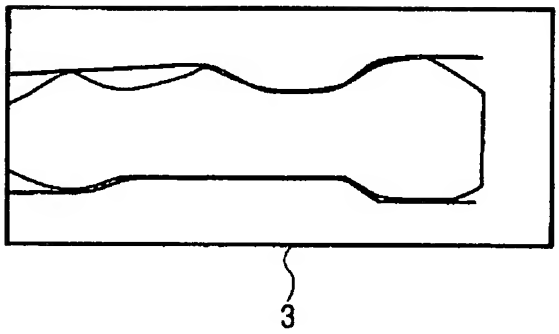


FIG. 1

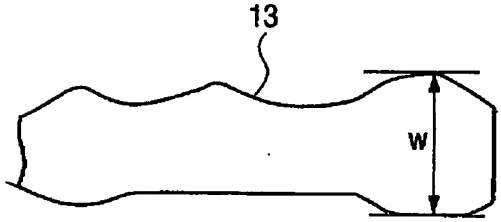


FIG. 2

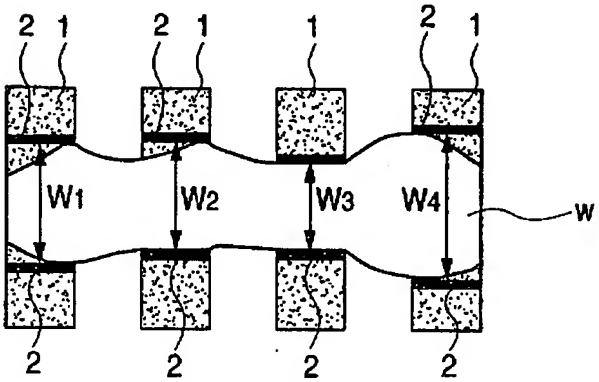


FIG. 3

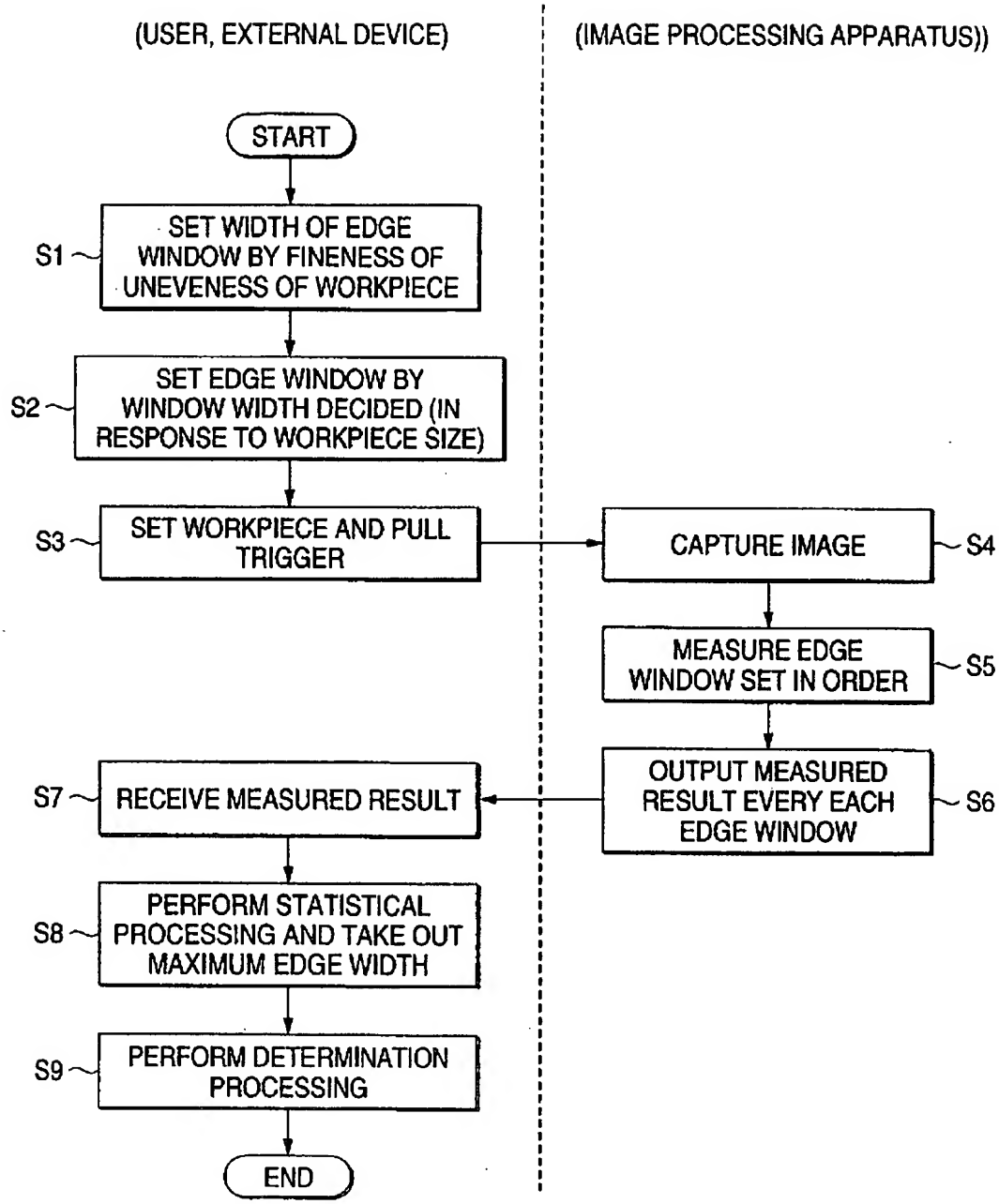

(USER, EXTERNAL DEVICE)
(IMAGE PROCESSING APPARATUS))
START
S1
SET WIDTH OF EDGE WINDOW BY FINENESS OF UNEVENESS OF WORKPIECE
S2
SET EDGE WINDOW BY WINDOW WIDTH DECIDED (IN RESPONSE TO WORKPIECE SIZE)
S3
SET WORKPIECE AND PULL TRIGGER
CAPTURE IMAGE
S4
MEASURE EDGE WINDOW SET IN ORDER
S5
OUTPUT MEASURED RESULT EVERY EACH EDGE WINDOW
S6
S7
RECEIVE MEASURED RESULT
S8
PERFORM STATISTICAL PROCESSING AND TAKE OUT MAXIMUM EDGE WIDTH
S9
PERFORM DETERMINATION PROCESSING
END

FIG. 4

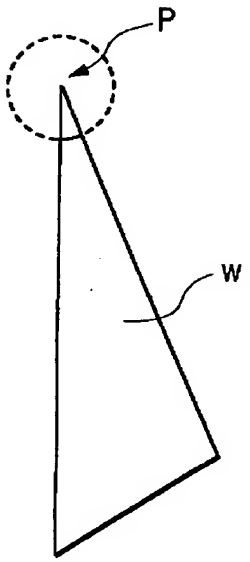


FIG. 5

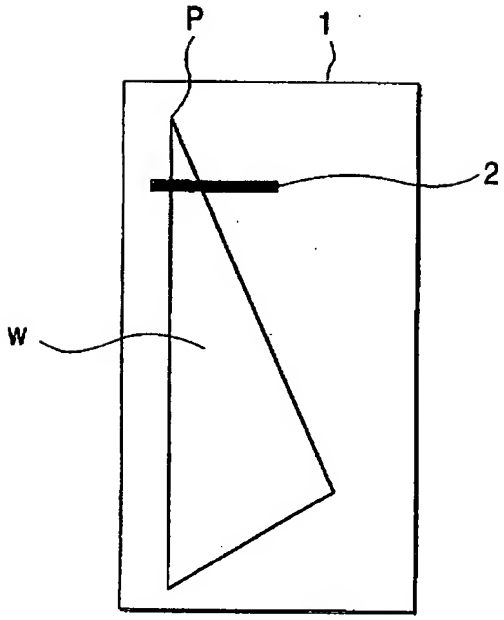


FIG. 6A

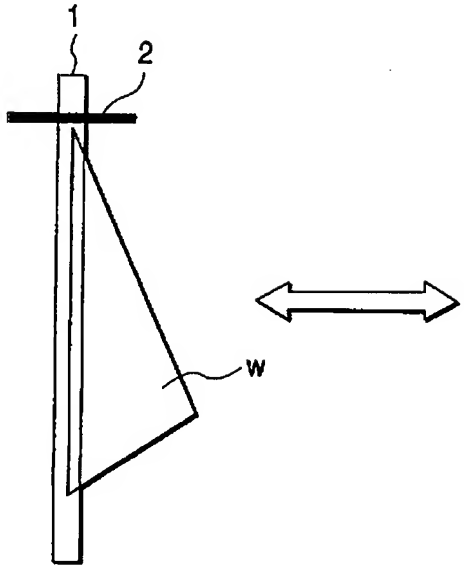


FIG. 6B